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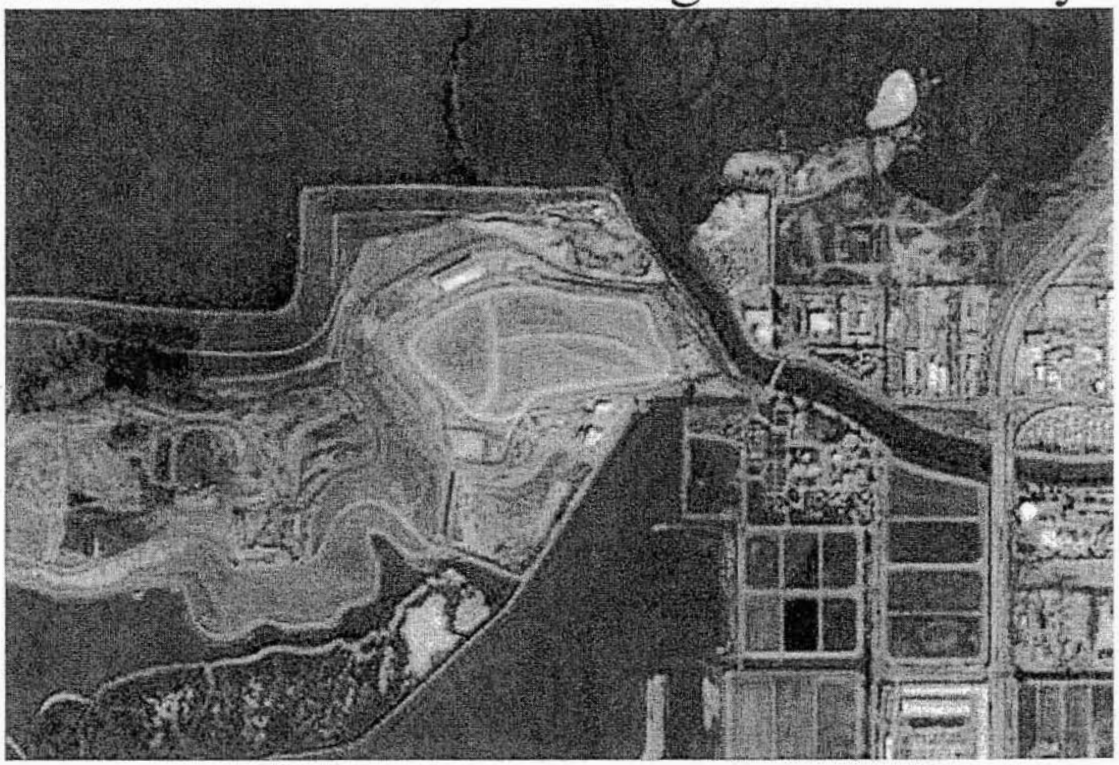

Work Plan for Improving Leachate Management Facility
Addendum-3
Plan for Improving Leachate Extraction and Conveyance Systems

(Department of Toxic Substances Control
Docket HWCA 20061079)

May 2, 2006

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West Contra Costa Sanitary Landfill
Hazardous Waste Management Facility
Richmond, Ca

May 2, 2006

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May 2, 2006

Report: Work Plan for Improving Leachate Management Facility
Addendum-3 Plan for Improving Leachate Extraction and Conveyance Systems (DTSC Docket HWCA 20061079)

I certify that this report has been prepared under my supervision and I am a registered Civil Engineer in the State of California.

Ian P.G. Hutchison, Ph.D.
President

5/2/2006
Date

Executive Summary

Since February 14, 2006, West Contra Costa Landfill (WCL) has maximized pumping from the Hazardous Waste Management Facility (HWMF) well field and the E-22R Area well field in order to meet the currently agreed upon daily leachate recovery rates of 21,600 and 3,000 gallons, respectively. Since February 14, over 1,500,000 gallons of leachate have been removed from the HWMF and the E-22 Area subsurface. This aggressive pumping program has achieved an inward hydraulic gradient in four (4) of the eight (8) piezometer pair locations at the HWMF used to measure gradient across the slurry wall, and a downward trend towards inward gradient has been observed in the remaining 4 locations.

This target daily volume was achieved during the period February 18 to April 10, 2006. Even with utilization of all functional extraction wells within the HWMF, leachate production fell to 15,800 gallons on April 10 and has currently stabilized at approximately 12,000 gallons per day. Throughout this period, the target of 3,000 gallons per day from the E-22R Area, which is included in the above volumes, has been met.

The declining yields from the HWMF were reported to DTSC as the leachate within the waste and geologic formations within the wells' radius of influence were dewatered. While the current daily production of approximately 12,000 gallons appears to be relatively stable at present, WCL anticipates a further decline in leachate production from the current wells as leachate levels continue to be lowered.

The aggressive accelerated rate of leachate extraction from the wells appears to have also resulted in areas of the cap experiencing differential settlement and subsidence. This condition is being closely monitored, and remedial action to repair the cap is likely to be necessary. Because of the importance of the cover to the overall function of the HWMF containment system, the rate of leachate extraction must be closely monitored and effectively managed to prevent further damage to the cover system.

Landfill cap need repair

The work plan structure is divided into three basic stages. The Stage 1 work is aimed at ensuring all the existing extraction wells in the HWMF/E-22R Area are operative. Repairs have been completed as required by the Order where possible, and additional well refurbishment and well pump upgrade work is currently being completed.

The Stage 2 work includes adding new wells at selected locations to increase the rate of leachate drawdown in certain areas of the HWMF/E-22R and to replace existing wells that cannot be refurbished. These new wells and the associated conveyance additions are planned to be installed during summer 2006.

The Stage 3 work addresses the eventual need to further enhance the extraction capability of the well system in order to sustain and maintain the inward gradient where achieved,

and to achieve and sustain the inward gradient in those areas where the inward trend is currently being established. The Stage 3 work will evaluate the field data and hydrogeologic information obtained from Stage 2 well placement activities in support of developing a long term extraction plan as the leachate levels continue to decline. Development of a long term extraction plan requires more field data and additional detailed hydrogeologic evaluations for both the HWMF and E-22R Area. These evaluations will proceed through 2006, including the data from the additional wells, culminating in an amended plan to be prepared by early 2007.

WCL is also undertaking substantial work to upgrade and eventually replace the existing leachate treatment plant facility. The leachate treatment plant work will include installation of a pilot plant, and the design and construction of new leachate treatment plant with enhanced treatment capabilities. The plant plans were provided in the March 10, 2006 work plan and subsequent April 3, 2006 submittals to DTSC.

Interim leachate treatment plant upgrades are expected to be undertaken pursuant to temporary authorization granted by DTSC. The upgrades include:

- Replacement of the two oil water separators (TK2 and TK-4) with rental units until replacement units arrive in June

- Replacement of the current TK-5 (UV/Peroxide) system with a HiPOx system that treats the organics with ozone and hydrogen peroxide. The system will be placed past the air stripper before the LGAC.

- Splitting of the flow from Flock Tank TK-8A to both of the existing onsite Clarifiers (TK-8 and TK-13). This will relieve bottle necks in the plant and allow for normalization of flow during varying influent conditions (metal concentrations)

- Introduction of flow from E-22R area to the process train prior to the Air Stripper. Water from E-22R area has metals concentrations below the discharge requirements, and causes an unnecessary burden on the metals treatment train

In addition to these short term modifications, WCL is requesting approval for a medium term upgrade for operations until the new system is designed, installed and is operational. Data from the medium term, the replacement system will be used in pilot studies to determine final design of the treatment system.

The equipment for the medium term upgrade will consist of:

- Replacement oil water separator (TK-2 and TK-4)

- Replacement of several above ground storage tanks as necessary

- Replacement of clarifier TK-8 with a larger capacity clarifier

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1.0 INTRODUCTION

1.1 Overview and Purpose

This Addendum No. 3 to the March 10, 2006, "Work Plan for Improving Leachate Treatment Capacity" (The Work Plan) outlines the leachate extraction system improvements that West County Landfill, Inc. (WCL) has undertaken, and proposes to undertake, at the Hazardous Waste Management Facility (HWMF) and the E-22R Area within the West Contra Costa Sanitary Landfill (WCCSL) (Figure 1). Previous addenda to the Work Plan have dealt with detailing the permitting requirements for the Leachate Treatment System (LTS) upgrades, and rehabilitating impacted wells using vacuum-truck liquid extraction.

This Addendum provides a Work Plan in response to Section 4.6 of the Department of Toxic Substances (DTSC), Enforcement Order, Docket HWCA 20061079 (Order), which requires Respondents to provide a Work Plan for department approval within 30 days of the date of the order recommending the number, placement, and design of extraction wells and conveyance system required to produce an inward hydraulic gradient within six months of the effective date of the Order.

In correspondence dated March 13, 2006, DTSC agreed that the above referenced Work Plan, i.e., this Addendum No. 3, is to be submitted on May 2, 2006. In the March 10, 2006, Work Plan, WCL provided a schedule for achieving inward hydraulic gradient that was consistent with field conditions encountered at the HWMF.

This Addendum No. 3 therefore provides a description of how WCL proposes to achieve and maintain an inward hydraulic gradient at the HWMF and E-22R areas. WCL's approach involves three stages that:

- maximize the current rate and reliability at which leachate is extracted from the HWMF and the E-22R Area,
- takes into account that various site conditions are still unknown and that data will continue to be generated, and
- provides a practical schedule for completing the necessary evaluation and design work in order to produce an effective and desirable long term system.

These three stages are as follows:

Stage 1: Short Term Well Repair Stage

This stage is aimed at ensuring all the existing extraction wells in the HWMF and E-22R Area are operative. Repairs have been completed as required by the order and additional well refurbishment and well pump upgrade work is currently being completed.

Stage 2: Medium Term New Well Program

This stage, (which has already begun), involves adding new wells that were selected to further increase the rate of leachate drawdown in certain areas of the HWMF and E-22R Area and to replace damaged or impaired wells that cannot be repaired or rehabilitated. These new wells and the associated conveyance additions will be installed this summer.

Stage 3: Long Term Extraction Well Plan

This stage addresses the eventual need to enhance the extraction capability of the wells as the leachate levels decline further and it becomes more evident where and how many additional wells may be needed. Development of such a "Long Term Extraction Well Plan" requires more field data and additional hydrogeologic and well hydraulic evaluations of both the HWMF and E22-R Area. These evaluations are scheduled to start immediately and will proceed through the period when additional wells are installed culminating in a plan by the early part of 2007.

The conveyance system plans include connecting all new wells to the conveyance pipelines in the HWMF, and a replacement/upgrade of the conveyance pipelines using more durable high density polyethylene (HDPE) piping (See March 10, 2006 Work Plan). The additional hook-ups are described in this Addendum No. 3. Preliminary designs of the upgraded system are provided.

1.2 Scope and Contents

The Scope and Content of this Work Plan is as follows:

- SECTION 2.0 - EXTRACTION WELL FIELD

This section describes the site conceptual model, geologic cross-sections through the HWMF, and a summary of the latest leachate levels. It also summarizes and evaluates the leachate removal achieved to date and lists the Stage 1 well repair and upgrade work that has been completed and is still ongoing.

- SECTION 3.0 - MEDIUM TERM PLAN FOR NEW WELLS & PIEZOMETERS
  This section provides a performance review of the gradient control achieved to date and discusses the plans for installing new extraction wells during Stage 2 (summer, 2006).

- SECTION 4.0 – MEDIUM TERM CONVEYANCE PIPING UPGRADES
  This section presents a description of the conveyance system piping, well head designs for both new and replacement wells, and well heads for the upgraded wells.

- SECTION 5.0 - WELL INSTALLATION PLANS & PROTOCOL
  This section outlines the details of the health and safety protocol, the well designs, and equipment specifications; the new well installation procedures; and well operating and maintenance procedures for the Medium Term Plan.

- SECTION 6.0 – OERATION AND MAINTENANCE
  This section describes operation and maintenance protocols for the extraction wells and pipeline leak detection systems.

- SECTION 7.0 - FINAL PLAN DEVELOPMENT
  This section provides a description of the additional hydrogeologic evaluations that will be undertaken and how this information will be used to establish whether additional wells are needed in the long-term. A description of the Long Term Extraction System Plan that deals with both the required extraction systems and how they will be operated in the long-term will also be included.

- SECTION 8.0 - SCHEDULE UPDATE
  This section provides an update to the overall schedule and describes how the work being done under this addendum relates to the other activities being conducted by WCL.

2.0 EXTRACTION WELL FIELD

2.1 Conceptual Model

2.1.1 General

The HWMF is capped and surrounded by a 5-foot-thick low-permeability, soil-attapulgite (SA) slurry wall (HWMF Slurry Wall) that acts as a passive containment barrier. A leachate collection and removal system (LCRS) and leachate treatment system (LTS) extracts and treats leachate from the HWMF.

The E-22R Area, located immediately east of the HWMF, is also capped and is bounded to the west by the HWMF slurry wall and to the north, east, and south by a 3-foot thick SA slurry wall (E-22R slurry wall) that connects with the HWMF slurry wall and serves to restrict groundwater migration from the E-22R Area towards San Pablo Creek (Figure 2). The E-22R Area also includes a leachate extraction system.

2.1.2 HWMF

The wastes contained in the HWMF are encapsulated above by the low permeability cover, laterally by low permeability slurry walls, and beneath by low permeability clay at the base of the landfill. This encapsulation minimizes the potential for leachate generation within the HWMF. Leachate storage within the area is currently being depleted by leachate extraction inside the HWMF perimeter slurry wall. Figure 3 shows detail north-south Cross section (A-A') of this encapsulation.

Geology

The HWMF is underlain by up to 60 feet of younger Bay mud which is generally a low-permeability, compressible silty clay to clayey silt. Three water bearing zones (WBZs) have been identified between the surface and a depth of 60 feet below mean seal level (MSL).

These include:

- The surficial WBZ (+20 to –10 feet MSL) is composed mostly of waste and fill, with some underlying natural Bay Mud sediments within the landfill.
- The shallow -WBZ (-10 to –30 feet MSL) consists predominantly of clay and clayey silt, with occasional sand and gravel lenses, stringers, or layers.
- The medium (-30 to -60 feet MSL) WBZ also consists of clay and clayey silt, with occasional sand and gravel lenses, stringers, or layers, with similar characteristics to the shallow WBZ.

The sand and gravel units within the surficial, shallow, and medium WBZs are generally separated from the sand and gravel units of the vertically adjacent zone, or laterally within the same zone, by low permeability silts and clays that act to restrict the potential for vertical and lateral migration of COCs dissolved in the groundwater at the site. The depth, thickness, and lateral extent of sand layers or lenses vary across the site, with the cumulative thickness of the sand layers being the greatest near San Pablo Creek and decreasing to the west. In the western half of the WCCSL, the surficial and shallow WBZs contain fewer sand layers and lenses, and contain more silt and clay than in the eastern portion of the WCCSL. At the Eastern perimeter of the HWMF, the sand layers within the surficial and shallow WBZs appear to be more extensive, and laterally continuous from the eastern boundary of the HWMF to San Pablo Creek.

Below depths of 60 feet to approximately 135 feet, dense, less compressible older bay mud clays and silts with occasional sand or gravel units are encountered. The zone is designated the deep WBZ. The occasional discontinuous sand and gravel units below 60 feet below MSL are generally fewer in number, but thicker than those above 60 feet below MSL.

Geologic sections showing the site stratigraphy were previously presented in the *Corrective Action Groundwater Monitoring Program, Hazardous Waste Management Facility, West Contra Costa Sanitary Landfill* (EMCON, 1997). An updated section, incorporating the cap is provided in Figures 3 and 3A.

The low permeability bay mud clays beneath the HWMF restrict vertical groundwater seepage into, or leachate seepage out of, the landfill. Since the discontinuous occasional thin sand stringers and lenses within the Bay Mud are cut off laterally in the surficial WBZ and upper half of the shallow WBZ by the slurry wall, the cumulative thickness of clays in the shallow and surficial WBZs serves to restrict the potential for vertical seepage of groundwater or leachate within the slurry wall containment area.

HWMF Design

The boring logs for the HWMF leachate extraction wells indicate that the elevation of the base of waste fill within the HWMF varies from approximately 3 to -11 feet MSL. The HWMF slurry wall extends downward into the shallow WBZ to elevations ranging from

12 feet below MSL to 26 feet below MSL. The current elevations of the base of waste fill and slurry walls may somewhat lower than originally reported due to consolidation within in the Bay Mud sediments that has occurred in response to the increase in overburden pressure associated with the construction of the HWMF final cover. The slurry wall was constructed with an average permeability of less than 1 x 10^{-7} cm/sec. This containment barrier restricts the potential for lateral flow of leachate and groundwater within the surficial WBZ and lateral flow of groundwater in the upper and mid portions of the shallow WBZ. During 2005, leachate potentiometric surface levels inboard of the HWMF slurry wall were approximately 3 to 10 feet higher than the surficial WBZ leachate levels or groundwater levels outboard of the slurry wall. Assuming the maximum permeability of 1 x 10^{-7} cm/sec for the HWMF slurry wall, a 30 effective percent porosity, and 3 to 10 feet difference in the leachate/groundwater potentiometric surface levels across the slurry wall, the rate of leachate seepage through the HWMF slurry wall is estimated to have been approximately 0.18 ft/yr to 0.6 ft/yr (i.e., approximately 2 to 7 inches per year) during 2005.

The 5.5-feet thick composite layered final cap includes, from bottom to top; a 1.5-feet thick clayey soil foundation layer, a 2-foot thick compacted low - permeability ($K \leq 1 \times 10^{-7}$ cm/sec) clay layer, a 60-mil thick linear low density polyethylene (LLDPE) geomembrane, a 0.5-foot thick drainage layer, and a 1.5-feet thick soil cover. The low permeability clay layer is connected to the slurry wall through a 2 foot high slurry wall extension (comprised of an admixture of low permeability ($K \leq 1 \times 10^{-7}$ cm/sec) soil and bentonite) that was constructed and compacted above the slurry wall specifically to facilitate the continuous connection between the two structures.

Prior to construction of the HWMF final cover over, the HWMF was capped by an interim low permeability clay cover. An analysis of the boring logs from the 23 leachate extraction wells installed in 1997 indicates that the average thickness of this interim clay cover was approximately 7 feet thick along the perimeter of the HWMF. Leachate potentiometric heads in most of the wells installed in 1997 were present under confined conditions beneath this interim cover.

The construction of the final cover over the HWMF increased the overburden pressure on the HWMF interim cover and as a result, the average potentiometric surface level in the inboard leachate piezometers along the HWMF slurry wall rose to approximately 24 feet above MSL, which is approximately 9 feet higher than at the onset of final cover

construction. The rise in leachate potentiometric surface elevations did not represent an increase in the volume of leachate, but rather a confined aquifer pressure response to the increase in overburden pressure. Nearly identical increasing trends in groundwater potentiometric surface elevations were observed in the shallow and medium WBZ wells located near the piezometers, again reflecting the confined aquifer response to the increase in overburden pressure.

Hydraulic Conditions

Although the leachate potentiometric surface elevation along the perimeter of the landfill rose to levels above the original surface elevation of the HWMF slurry wall, the confined conditions created by the combined interim and final covers and the continuous connection between the final cover and the slurry wall precluded any significant seepage of leachate over the top of the slurry wall. Uplift calculations performed by EMCON/OWT, Inc., to assess the integrity of the final cover under the highest potentiometric surface elevation conditions at the HWMF (i.e., at the end of final cover construction) indicate that there was sufficient factor of safety (FS value range: 1.55 to 11) to prevent a failure of the 5-foot-wideconnection between the final cover and the slurry wall due to these pressures.

Previous numerical modeling of groundwater extraction at the site (EMCON, 1996) has predicted that groundwater inflow into the HWMF would be approximately 1.4 gallons per minute (gpm) after leachate extraction along the perimeter of the landfill had created an inward hydraulic gradient of 0.2 ft/ft (one foot hydraulic head differential) across the HWMF slurry wall. For purposes of the work being currently undertaken, it is assumed these "residual flows" could be as high as 5 to 8 gpm (see March 10, 2006 Work Plan). The rate at which the inward hydraulic gradient is established is a function of the rate of leachate flow to the extraction wells. Although leachate has recently been extracted at a rate greater than anticipated in the 1996 numerical modeling, the recent significant decline in leachate extraction rates is consistent with the general trend of the model predictions.

2.1.3 E-22R Area

The interface between the overlying earth fill and/or waste fill in the E-22R area and the underlying bay mud sediments varies from approximately 2 feet above MSL to 7 feet below MSL throughout the E-22R area. The E-22R area is surrounded on the north, east, and south by a 3-foot thick conventional soil-bentonite slurry wall; and on the west by the

5-foot thick HWMF SA slurry wall. Similar to the HWMF slurry wall, the E-22R slurry wall was constructed to have a hydraulic conductivity of less than 1×10^{-7} cm/s.

The base of the E-22R slurry wall was constructed to elevations between 17 feet below MSL and 32 feet below MSL. This is deeper than at the HWMF slurry wall given that the cumulative thickness and occurrences of sand layers in the Bay Mud sediments increases near San Pablo Creek. The E-22R slurry wall restricts the potential for lateral flow of leachate and groundwater within the surficial WBZ and lateral flow of groundwater in most of the shallow WBZ adjacent to San Pablo Creek. During 2005, leachate potentiometric surface elevations inboard of the E-22R slurry wall were typically 7 to 9 feet higher than the average groundwater elevations outboard of the slurry wall. Assuming the maximum permeability of 1×10^{-7} cm/sec for the E-22R slurry wall, a 30 effective percent porosity, and 7 to 9 feet difference in the leachate/groundwater potentiometric surface levels across the slurry wall, the rate of leachate seepage through the E-22R slurry wall is estimated to have been approximately 0.8 ft/yr to 1.0 ft/yr during 2005.

Average annual leachate levels in the E-22R Area increased by approximately 1 foot between 1997 (9.3 feet above MSL) and 2005 (10.3 feet above MSL). In contrast, the average groundwater levels east and south of the E-22R slurry wall are approximately 1.5 feet above MSL and 2.7 feet above MSL, respectively. Target leachate levels for the creation of an inward hydraulic gradient across the E-22R area slurry wall are approximately 0.5 feet below MSL for the northern and eastern legs of the E-22R slurry wall and 0.7 feet above MSL for the southern portion of the slurry leg of the wall. An outward hydraulic gradient from the E-22R area into the HWMF is planned across the HWMF slurry wall along the western perimeter of the E-22R area.

After leachate storage in this area is depleted, the approximate steady state rate of leachate extraction in the E-22R area is likely to be similar to or slightly greater than that of the HWMF as the sand layers in this area are thicker and more extensive and the aquitard material separating vertically adjacent sands are thinner and contain a higher fraction of silt than under the HWMF.

2.2 Leachate Extraction Achieved to Date

Since February 14, 2006, WCL has maximized pumping from the HWMF well field in order to comply with DTSC's request for a daily removal rate of 21,600 gallons. In addition, 3,000 gallons per day of leachate was extracted from the E-22R Area. The daily target volume from the HWMF was achieved during the period from February 18 to April 10, 2006. Despite usage of all functional extraction wells within the HWMF, leachate production fell to 15,800 gallons on April 10 and has currently stabilized at approximately 12,000 gallons per day.

Since February 14, 2006, an estimated total of 1,500,000 gallons of leachate were extracted from the HWMF and E-22R Area. Of this, 1,300,000 gallons of leachate were from the HWMF subsurface, and an additional 200,000 gallons were extracted from the E-22R Area.

Hydraulic gradient across the HWMF slurry wall has responded favorably to increased pumping in the short term. An inward hydraulic gradient has been achieved at 4 of the 8 piezometer pair locations and a decreasing trend in the outward hydraulic gradient has been observed in the remaining four.

The declining yields observed over the past several weeks were anticipated as leachate storage within the HWMF is depleted and the waste and geologic formation within the wells' radius of influence dewaters. While the current daily production of approximately 12,000 gallons appears to be relatively stable at present, a further decline in leachate production rate is likely to occur as leachate storage continues to be depleted.

The accelerated rate of leachate extraction from the wells has also resulted in the introduction of light non-aqueous phase liquid (LNAPL) into some wells. The highly viscous LNAPL has already rendered two of the leachate extraction wells inoperable because the LNAPL cannot be readily pumped by the well's electric submersible pumps. WCL is currently in the process of replacing the electric pumps in the LNAPL impacted wells with pneumatic pumps in order to return these wells to service.